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Joint Mission Environment Test Capability (JMETC)

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During the past six years, utilizing the concept of Joint Operations has become standard for successful U.S. military combat. The need for Joint interdependency and Joint systems interoperability during combat operations in Afghanistan and Iraq is irrefutable. Consequently, Joint lessons learned are rapidly being incorporated in combat operations and Service/Joint training programs.

However, Joint lessons have proven to be elusive and slow to take hold in the Department of Defense (DoD) acquisition and testing communities. Despite the popularity of the common catch phrase "Born Joint," many systems are fielded without a rigorous and credible test of their capabilities in a Joint operating environment. Performance of Joint systems must be evaluated in a Joint environment, and the only way to do that effectively, efficiently, and early in acquisition is to link distributed high-fidelity test facilities creating a realistic Joint environment. However, the proliferation of unique, noninteroperable, and expensive testing infrastructures remains widespread within the DoD.

To effectively and efficiently test systems in a Joint environment, the DoD needed an enterprise-level LVC distributed test capability using a common infrastructure. The Joint Mission Environment Test Capability (JMETC) program was initiated in FY 07 to meet that need. This article provides a brief description of the JMETC program and the capabilities it is providing, as well as its recent accomplishments.

Key words: Integral Fire 07; InterTEC Spiral 2, Build 1; JMETC program; JMETC Users Group; JMETC Virtual Private Network (VPN); LVC; Object Models; reuse repository; warfighter.

The proliferation of unique, noninteroperable, and expensive testing infrastructures remains widespread within the DoD. The current DoD test community contains a number of stand-alone test resources that:

- Lack a standard capability to collaborate and exchange data between facilities, which can result in duplicate efforts among similar programs
- Contain unique software that must be integrated for each test activity, adding to test preparation time and expense
- Use data definitions that are often unique and noninteroperable, complicating integration into Joint systems and system capabilities
- Require long lead times to establish security agreements needed to link them together on a network for each test (most such agreements are generally in effect for one test event).

The lack of universal tools and a common infrastructure also impacts test planning, coordination, and execution. Each program spends time and money establishing or re-establishing a live, virtual, and constructive (LVC) test environment and a network configuration for each test.

The JMETC program is a new program, formally established in October 2006. In actuality, the need for JMETC was established years earlier as reviewed in this section.

In March 2004, the Strategic Planning Guidance (SPG) on Joint Testing in Force Transformation stated that developing and fielding Joint force capabilities requires adequate, realistic test and evaluation (T&E) in a Joint operational context. The SPG

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directed development of a Roadmap to define changes to ensure that T&E is conducted in a Joint environment and facilitates the fielding of Joint capabilities.

The DoD *Testing in a Joint Environment Roadmap*, approved by the Deputy Secretary of Defense, November 2004, identified actions to implement testing in a Joint environment. One action was to establish a corporate capability for Joint distributed testing.

The JMETC Program originated with the 2005 Department direction for the stand-up of the JMETC Program in FY 07 under the Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L). AT&L assigned responsibility for execution to the Director, Test Resource Management Center (TRMC). The JMETC Program Office was stood up in October 2006 and in the past year has made great strides in establishing and executing the program.

Program description

The JMETC mission is to provide a DoD corporate approach for linking distributed facilities on a persistent network, thus enabling customers to develop and test warfighting capabilities in a realistic Joint context. Customers include *Program Managers* (Acquisition Program Managers, Portfolio Managers, Advanced Concept Technology Demonstration Managers, etc.), *Test Agents* (Organizations designated by Program Managers to lead their event test planning and execution, e.g., White Sands Missile Range and Edwards AFB) and *Resource Owners* (capabilities owned across the department and in industry used to test warfighting capabilities).

In addition to DoD customers, industry is a key participant in a successful DoD "corporate approach" to linking distributed facilities. Industry owns many of the resources that must be linked together to create a Joint environment. There are two ways in which industry can participate in the JMETC infrastructure. One is to perform tests in support of a government contract. The second is for industry to fund the addition of their facilities onto the JMETC Virtual Private Network (VPN). In addition, industry is welcome to participate in the JMETC users group or the Testing and Training Enabling Architecture (TENA) Architecture Management Team (AMT).

The JMETC program relies heavily on the collaboration of the Services, Joint Forces Command (JFCOM) and agencies to build an infrastructure relevant to current and future requirements. In order to facilitate and formalize this exchange, the program office instituted the JMETC Users Group. The group is composed of representatives from acquisition program offices, technical experts, and representatives from ranges that are potential users of the JMETC infrastructure and products. Its focus is on technical requirements and solutions. It makes recommendations to improve JMETC processes and procedures and determines the TENA priorities for the Test Community prior to TENA AMT meetings.

Just as the JMETC Users Group provides a collaborative environment for JMETC, the TENA AMT meetings provide a technical forum for open dialogue between users and TENA developers. The group identifies issues, vets concerns, debates solutions, and agrees on a way forward. Currently, over 27 companies are members of the TENA AMT. TENA middleware and object models are freely available at www.tena-sda.org.

JMETC is used whenever you need to link resources together to conduct a distributed test event and supports events, such as Developmental Testing, Operational Testing, Interoperability Certification, Net-Ready Key Performance Parameter (KPP) compliance testing, and Joint Mission Capability Portfolio testing. JMETC's ability to support the full spectrum of testing makes JMETC a true DoD corporate solution for distributed testing.

The JMETC program consists of both products and services. Products include a core reusable and easily reconfigurable infrastructure that also provides compatibility between test and training. JMETC services include a customer support team to assist in the use of JMETC products and to assist in the planning and execution of distributed testing.

Specifically, the JMETC infrastructure consists of the following six products that form the bedrock of JMETC capability. Each is being developed and matured through active coordination with the Services, JFCOM, test programs, and other T&E agencies. Each of these products will be refined as the capability and user requirements within the Joint infrastructure mature.

1. Persistent Connectivity. The JMETC program has established and is maintaining a dedicated virtual private network. The current sites will be expanded based on customer requirements and potential for reuse. This is a readily available, corporate integrated network centrally managed and configured to provide long haul information transfer services. In technical terms, it is not a true VPN, yet it is "VPN like," operating over a broad mesh network of active sites on the Secret Defense Research and Engineering Network (SDREN). After an analysis of alternatives, JMETC selected SDREN due to existing sites at test facilities, existing security agreements and procedures, available encryption devices needed for secure connectivity, and cost considerations. Key to this capability are the

persistent security agreements that will reduce event preparation time and effort by virtue of the fact that they are persistent.

Once an initial entry on to the net is achieved and the location has the authority to connect, that location will then have a persistent network connection on the JMETC VPN. There will be no need for multiple security agreements with every other location on the network or the need to redo the agreements for each subsequent event, since the network connections will not be event or time specific. This persistency lowers test preparation time and cost of future test events.

2. Middleware. The JMETC program provides a data exchange software used by range systems, laboratories, and simulations to send and receive data. It allows for common functionality (data distribution, filtering, etc.) to exchange data or information between systems on the JMETC VPN. Many JMETC locations already use the Test and Training Enabling Architecture (TENA). In an analysis of alternatives study of LVC integration capabilities, JMETC selected TENA for the infrastructure's data exchange software since it was already being used, could satisfy demanding real-time performance requirements, was easy to integrate, and had a well-established improvement process to incorporate new technologies (TENA 6.0 will be available in FY 08). Furthermore, gateway devices have been developed that enable TENA to connect to other data exchange protocols such as distributed interactive simulation (DIS) and High-Level Architecture (HLA). TENA is also used by the Joint National Training Capability (JNTC) thus providing a solution common to both the test and training communities.

3. Standard Interface Definitions and Software Algorithms. This is a collection of Object Models that provide a common language used in data exchanges between the systems integrated together in a distributed event. Most significantly, Object Models provide the standard data definitions and interfaces of the numerous configured systems (such as radars, tracking systems, GPS instrumentation, hardware-in-the-loop laboratories, display systems, analysis terminals, etc.), specifying what data can be generated by and collected from each system. Object Models not only define the data elements being exchanged, but also provide common algorithms (such as, coordinate conversions, unit conversions, dead-reckoning, etc.), aiding interoperability, and data analysis. In other words, they serve as the object-oriented interface to a service available over the network or system being integrated. Such an interface is said to be the *Object Model* of the represented service or system. JMETC uses the TENA Object Models to provide the standard data definitions set.

4. Distributed Test Support Tools. The JMETC program will use a collection of common software applications that help test managers plan, prepare, set up, check out, monitor, and analyze the distributed LVC integration. The JMETC Users Group will use a "best-of-breed" process to identify the existing tools across the Services and Agencies. This suite of universal test planning, set-up, monitoring, and control tools will provide easy, reliable, and uniform test tools for integration of test assets. The standard set of tools enables reuse from event to event, diminishing a program's need to rely on a unique toolset. This improves coordination and reduces event planning and preparation time—not only saving test programs time and money, but also allowing them to capitalize on similar efforts and programs already completed.

5. Data Management Solutions. In the future, the JMETC program will have a suite of data archiving solutions designed to store and transport collected test data from multiple locations. It will provide a rapid and efficient method of retrieving data from distributed test locations for analysis and enhanced evaluation of test results. The Central Test and Evaluation Investment Program (CTEIP), under the TRMC, is conducting an assessment of T&E data management requirements. Leveraging the efforts of the CTEIP activity, JMETC will adopt and advocate the proposed data management solutions. JMETC will also participate in and represent LVC integration interests in the CTEIP data management requirements assessment effort, and will keep JMETC customers informed of the latest status through the JMETC Users Group.

6. Reuse Repository. The repository will provide a Web portal with a variety of services valuable for all JMETC users. Available via the world-wide web, the Reuse Repository will provide customers with access to JMETC information, including the latest middleware, object models, available software tools, documentation, how-to guides, and Web-enabled collaboration services. In addition, the Reuse Repository will also contain information and references to past events support by JMETC, capturing general configuration information, lessons learned, recommended practices, and other relevant LVC integration information. Allowing test programs to leverage the success of similar efforts and events, the Reuse Repository will reduce event planning time by providing customers a "one-stop-shop" for existing and available LVC capabilities. The planners will not have to start from scratch for each event, and operators, testers, and the acquisition community will have access to a tremendous readily accessible library of lessons learned.

Figure 1 is an operational view of JMETC's infrastructure. The systems under test, depicted in

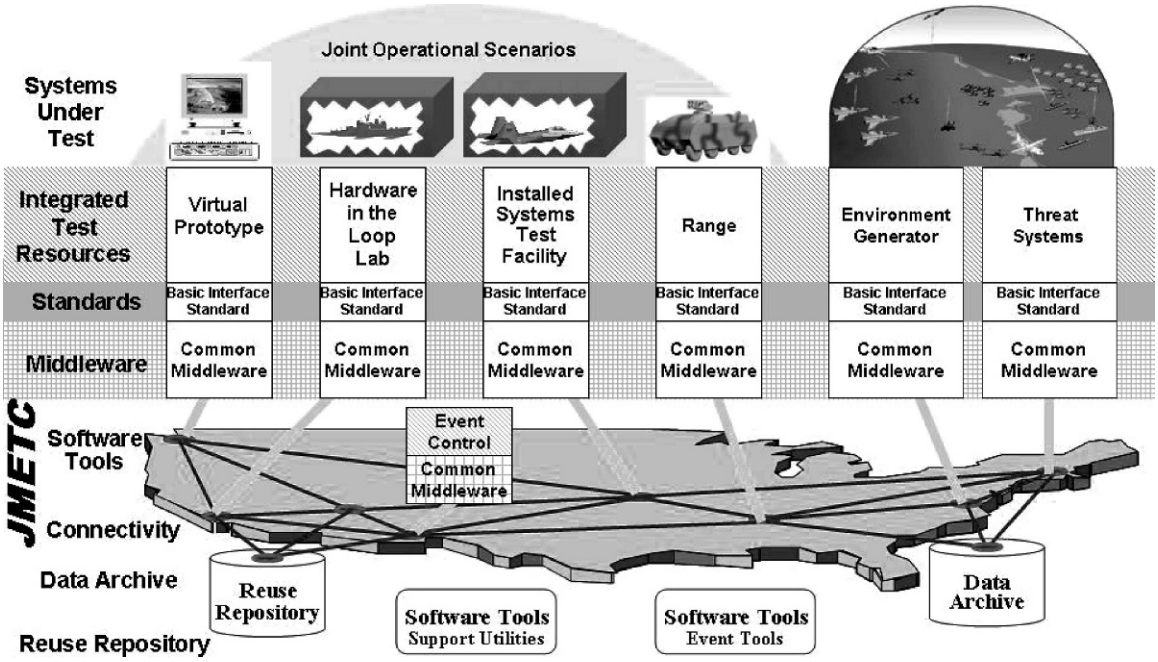

Figure 1. JMETC infrastructure capability

the top row along with the test environment and threat systems, are represented by virtual simulations, hardware-in-the-loop facilities, constructive simulations, and live systems. The solid colored row represents the standard TENA interfaces needed for those LVC representations to communicate. The grid patterned row represents the middleware used to control the flow of data across the network. The lines on the map represent the JMETC VPN which uses the SDREN. The rounded rectangles represent the software tools needed to support and control the distribute test. The cylinders represent the JMETC reuse repository which will contain items relevant to distributed testing, such as information for test planning, available integration software and tools, test facilities descriptions, and past event lessons learned, among others.

JMETC is not developing a new or unique DoD network. It is leveraging existing connectivity and proven network tools to provide a common infrastructure linking test facilities and laboratories to provide a Joint distributed environment for the system under test. Reuse is an important tenet for establishing the JMETC infrastructure. Rather than having each acquisition program establish special network agreements with each site, develop specific data converters, and create unique integration tools, JMETC provides a foundation of networking and supporting infrastructure that future customers can reuse for their distributed test events. For example, the security agreement established with the F/A-18 laboratory at China Lake for the JMETC VPN can be (and has been) reused with other customers, enabling future customers to connect to the F/A-18 laboratory without several months of effort.

In addition to the six products, JMETC also provides a customer support team to assist in using JMETC products as well as expertise in distributed LVC testing. JMETC can provide a dedicated technical representative for each customer to assist with infrastructure requirements definition in addition to planning, preparing, and executing the distributed test event.

Establishing the JMETC VPN

In May 2007, the dedicated JMETC VPN was established on the SDREN. The JMETC program worked closely with the High Performance Computing Modernization Program Office (HPCMPO) on connectivity and security issues to create the JMETC VPN in time to support its first distributed test event, Integral Fire 07, in July 2007. Establishing and verifying the JMETC VPN is a significant step in providing the persistent LVC environment needed to conduct distributed Joint testing. The JMETC VPN provides readily available, persistent connectivity using standing security agreements and common tools to integrate system representations for distributed testing.

In support of the Integral Fire 07 test event, five sites (White Sands Missile Range, Eglin, Redstone Technical Test Center, China Lake, and Patuxent River) were established on the JMETC VPN with standing security agreements. In addition, JMETC used the Network Aggregator Router at Patuxent River, originally spon-

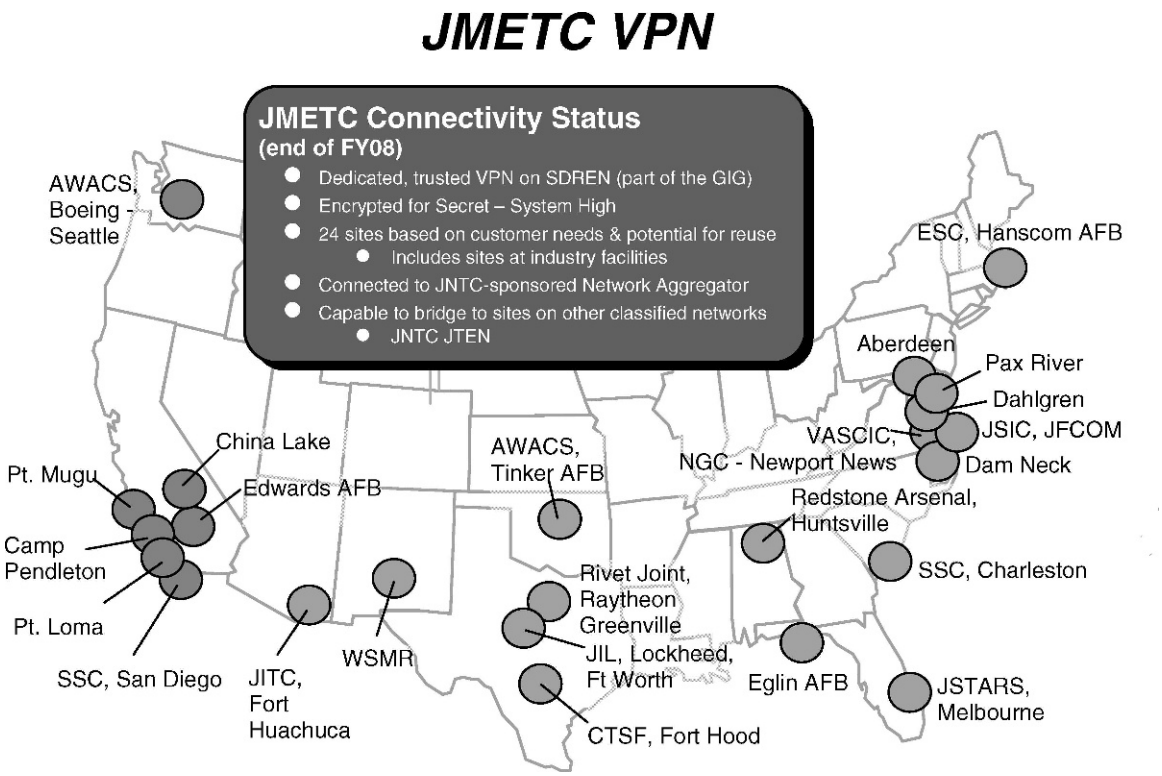

Figure 2. JMETC VPN sites FY07-08

sored by JNTC, to link an additional ten sites, leveraging existing connection agreements to satisfy Integral Fire 07 requirements. Most significantly, this Network Aggregator Router enables JMETC to connect to many other DoD networks, including the Joint Training and Experimentation Network (JTEN) used by JNTC, providing connectivity to all the joint training locations. An additional two sites (Pt. Mugu and Ft. Huachuca) were added to the JMETC VPN to support the second test event in September 2007 called Interoperability Test and Evaluation Capability (InterTEC) Spiral 2 Build 2. (A more detailed description of these tests is provided later in this article.) By the end of FY 08, JMETC expects to create a total of 24 sites in response to customer requirements on the JMETC VPN (see *Figure 2*). This infrastructure will remain available for reuse by future programs for their distributed test events.

Integral Fire 07 - First distributed test event supported by JMETC

Integral Fire 07, completed in August 2007, represented the inaugural use of the JMETC VPN to formally support a distributed test. Integral Fire 07 was a distributed test event sponsored by the Air Force Integrated Collaborative Environment (AF-ICE) and involved all military Services and JFCOM. The customers were JFCOM's Joint Systems Integration Command (JSIC), the Joint Test and Evaluation Methodology (JTEM) Joint Test and Evaluation (JT&E) project, and the Warplan-Warfighter Forwarder (WWF) initiative, sponsored by the U.S. Air Force Command and Control Intelligence, Surveillance, and Reconnaissance Battlelab.

For Integral Fire 07, the JMETC program created a single infrastructure that served all three distinct customers with different requirements, as described below, who were able to test independently in the same time frame, thereby making multiple use of the same infrastructure.

- JFCOM's JSIC conducted an assessment of Joint Close Air Support (CAS) to evaluate the capability of Joint Terminal Air Controller equipment to support digital operations in a distributed Joint environment. Specific emphasis was on the immediate request process for CAS, with the goal to identify gaps, shortfalls, and overlaps with current systems.
- The JTEM JT&E project led a test activity exercising their methods and processes while also providing insight to the Army's Non-Line of Sight/Precision Attack Missile (NLOS/PAM) emerging weapons concepts.
- The USAF WWF initiative tested Non-Line of Sight/Network Enabled Weapon (NLOS/

NEW) Command and Control concepts leveraging the Joint Air-to-Surface Standoff Missile-Extended Range weapons system. Specifically, WWF assessed machine-to-machine data transferred from the Air Operations Center to an airborne platform and then directed to NEW.

The JMETC program was the infrastructure lead for Integral Fire 07. As such, JMETC was responsible for connecting not only the five JMETC sites, but also connecting two other separate enclaves with the JMETC enclave using the JFCOM sponsored JNTC aggregation router. TENA was successfully used to exchange all simulation and instrumentation data between sites. Specifically within their laboratories, nine sites used DIS Protocol Data Units. At each of these local DIS sites, the data was converted to TENA using a DIS-to-TENA Gateway device prior to being sent to another site, mitigating the configuration challenges of using DIS over wide-area networks.

JMETC conducted systems integration, site surveys, and multiple dry runs. All site preparations were completed in time for the three test customers to achieve all test objectives during execution of the two-week event. JMETC also achieved its own four main objectives:

1. Stand up the JMETC VPN
2. Successfully use the Aggregation Router to link three enclaves
3. Support three customers conducting tests using the same network in the same time frame
4. Record lessons learned to improve support in future events.

JMETC's success in providing the infrastructure for Integral Fire 07 is a significant stepping stone for other Service and Joint programs to leverage a core reusable and easily reconfigurable infrastructure.

InterTEC Spiral 2, Build 1 – Second distributed test event supported by JMETC

InterTEC Spiral 2, Build 1, completed in October 2007, represented the second use of the JMETC VPN to formally support a distributed test.

Interoperability T&E Capability (InterTEC) is an OSD-sponsored, U.S. Navy-led project under the Central T&E Investment Program (CTEIP). The purpose of the InterTEC project is to develop an accredited test capability to conduct joint interoperability certification and joint mission thread testing. Spiral 2, Build 1 objectives were developing and assessing tools to test joint threads and assessing the C2 messages sent from sensors to shooters through command and control systems (GCCS-J, GCCS-M, GCCS-A, and TBMCS).

JMETC program responsibilities included taking the overall lead for creating the infrastructure; integrating six sites (five sites on the JMETC VPN and one through the Aggregation Router); conducting systems integration, site surveys, and dry runs in preparation for the event; and overseeing operation of the network and dataflow among all sites during the event. In addition, just as in Integral Fire, TENA was used as the integrating solution to link each site.

The JMETC program successfully supported execution of InterTEC Spiral 2 Build 1 along with completing the following significant accomplishments:

- Established three new sites on the JMETC VPN within 90 days
- Demonstrated reuse (three sites from Integral Fire 07 test)
- Successfully use the Aggregation Router for the second time

JMETC's successful support for this second distributed test event validated the reusability of the JMETC infrastructure, emphasizing the efficiencies of cost and schedule provided by using the JMETC program.

Benefits

The warfighter is the ultimate beneficiary of the JMETC capability. Using the JMETC infrastructure, Program Managers can more effectively and efficiently link distributed test facilities to create a realistic joint environment for testing weapon systems in the environment they are intended to operate. This means they can conduct a more rigorous test of weapons systems and the capabilities of those systems in the environment they are intended to operate, thus improving system interoperability during joint combat operations. Also, since JMETC will be interoperable with the JNTC, program managers will be able to easily link to JNTC sites in order to conduct joint test and training events—a significant benefit to both the test and training communities.

Program managers will save both cost and time when conducting distributed test events using the JMETC VPN sites, the TENA common middleware, standard test planning tools and reuse repository. Instead of creating their own infrastructure and security agreements for each test event, program managers can use JMETC's readily available, corporate integrated network with persistent security agreements. The standing security agreements for the JMETC VPN sites alone will save significant event preparation time. Using the TENA common middleware will make it easier to integrate distributed systems and avoid compatibility issues. TENA will also negate the need to develop unique software solutions so systems can exchange data. Also, TENA will cost the program

manager nothing; it is free to download by any user, government or industry.

Another benefit that will save time and cost is the standard test planning tools. Using common tools enables reuse from event to event; this diminishes a program's need to rely on a unique toolset and will improve coordination. In addition, this reduces event planning and set up time. The reuse repository will also save cost and time by allowing programs to leverage the success of similar efforts and events as well serve as a one-stop-shop for LVC capabilities. A significant benefit to the test community is the gateways that JMETC is developing that allow users to connect TENA sites to other legacy data exchange software solutions such as DIS and HLA. This will allow users to connect to these sites through the JMETC VPN without having to modify them.

Users will also find the technical expertise provided by JMETC extremely beneficial. JMETC engineers will assist not only in using JMETC products but also in LVC test event planning and execution. These types of distributed events can be very challenging and JMETC engineers have significant distributed testing experience. Also, unique to JMETC is that customers can help guide the program in the direction that meets their needs and requirements through participation in the users group and the TENA AMT. Collaboration with the Services and Industry is a key element to JMETC implementation and expansion.

In the one short year that JMETC has existed, the Department is already recognizing its benefits. These benefits will significantly increase as the JMETC infrastructure expands and need for joint systems interoperability testing increases.

Conclusion

JMETC is no longer a proposed capability, it is an established capability. The JMETC corporate approach for linking distributed facilities enables T&E and acquisition community customers to evaluate new and legacy systems in a Joint context. Increasing customer requirements for the JMETC capability is driving rapid expansion and demand for the JMETC VPN resulting in increased benefits to each customer.

The JMETC Program Office is aggressively working with multiple programs to determine how requirements can be met. The collaborative support from the Services and JFCOM, as well as their contribution to the accomplishments achieved in the first year, is appreciated. It is encouraged that potential customers contact the organization so they can begin early coordination for their program test planning and event support.

JMETC is the corporate solution for joint distributed testing and is here now! ❑

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GEORGE RUMFORD, systems engineer, chairs the JMETC Users group, an entity of customers and potential customers that meets quarterly to review JMETC features, sites, and future plans. The test community is encouraged to participate in these meetings. E-mail: George.Rumford@osd.mil.